AGUA HEDIONDA 2020 ANNUAL REPORT

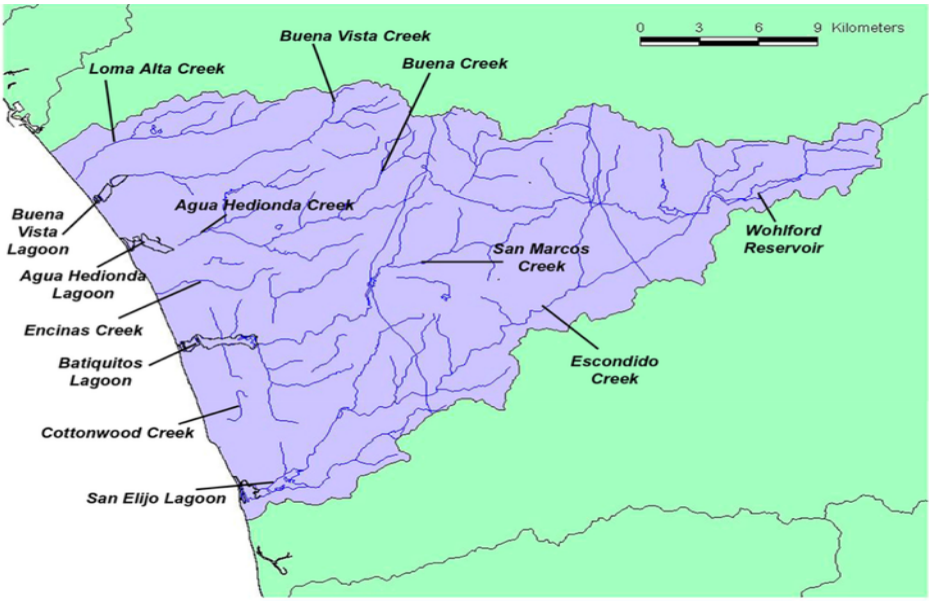
Prepared by Karen Merrill and Ellen Bartlett, Preserve Calavera, North San Diego County Watershed Monitoring Program

We would also like to acknowledge the time and effort of our field volunteers who make this all possible: Scott Engel, Mary Anne Viney, Karen Merrill, Jan Neff-Sinclair, and Janell Cannon .

Background

In the spring of 2019 Preserve Calavera created the North San Diego County Watershed Monitoring Program (NSDCWMP) to carry on the decade-long work of San Diego Coastkeeper (SDCK) to assess the health of local surface waters. The three watersheds of Carlsbad's lagoons, all of which are part of the Carlsbad Hydrologic Unit, are evaluated for a variety of physical, chemical and biological parameters on a bimonthly basis.

Figure 1 *(right). The Carlsbad watershed, including major waterways. (Source: SWAMP)*

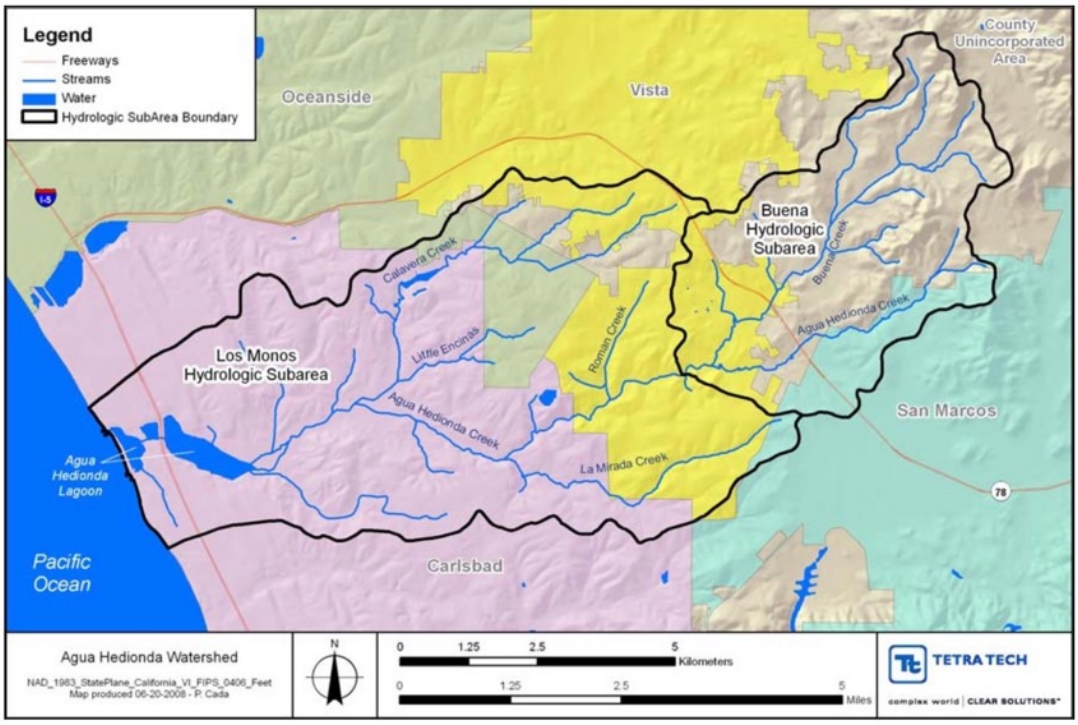


NSDCWMP is an all-volunteer citizen science effort with a leadership management team comprised of two Preserve Calavera board members (also leaders of the Buena Vista Creek and Agua Hedionda Lagoon monitoring teams) and a representative from and leader of the Batiquitos Lagoon team. Our technical advisors are from the CA Waterboard and the San Diego Regional Water Quality Control Board (SDRWCB). Data is posted at www.preservecalavera.org. Monitoring data for the Carlsbad Watershed can also be accessed through the California Environmental Data Exchange Network (CEDEN) www.ceden.org or the WQIP Annual Reports. The program began testing in July 2019.

The Agua Hedionda Watershed begins along the southwestern slopes of the San Marcos Mountains and flows over 10 miles until discharging into the Pacific Ocean at the Agua Hedionda Lagoon in Carlsbad. The watershed includes portions of Carlsbad, Vista, Oceanside, and San Marcos, as well unincorporated portions of San Diego County. The Lagoon extends inland for about 1.7 miles and it is 0.5 miles wide at its widest point. As a result of Highway 101, Interstate 5 and Highway 101, the lagoon has been split into 3 waterway sections as you move inland from the coast: the outer, middle and inner lagoon.

***Figure 2**: Agua Hedionda Lagoon; It's three sections are visible (Source: Google Maps)*

Figure 3: Agua Hedionda Watershed with two subareas outlined (Agua Hedionda Watershed Management Plan)



Agua Hedionda is the only lagoon in San Diego County that supports commercial and recreational uses. Carlsbad Desalinization Plant, Hubbs Seaworld fish hatchery and Carlsbad Aquafarm are at the west end; Ecke Family YMCA Aquatic Park, California Watersports and boat ramps are in the center section and a state ecological reserve and nature center are at the east end. The inner lagoon is designated REC-1 beneficial use (water sports) and the outer lagoon SHELL-1 for the aquafarm.

Two events occurred in 2020 that will effect the environment of the lagoon:

- Installation of new fish-friendly seawater intake pumps at the Carlsbad Desalination Plant was complete in June of 2020. The three intake pumps are part of a broader effort to ensure the long-term health of the marine environment near the Desalination Plant.
- AB-1949 Fisheries: California Ocean Resources Enhancement and Hatchery Program was passed in September, 2020. The Bill strengthens and expands the marine fish hatchery program at the lagoon's fish hatchery and aquafarm— allowing additional breeding of the native California species that have been depleted by commercial and recreational fishing.

The Creek itself has been listed as impaired under Section 303(d) of the Clean Water Act for heightened bacteria levels, toxicity, and elevated concentrations of manganese, phosphorus, selenium, nitrogen, and dissolved solids. The Agua Hedionda Lagoon, which had previously been listed as impaired, has seen significant improvements in overall water quality over the last few years that warranted its removal from the 303(d) list of impaired water bodies.[1]

Lagoon Dredging:

As a result of accumulated sedimentation, and the absence of significant tidal flushing, the lagoon was becoming an increasingly restricted salt water marsh. The entire lagoon was dredged and permanently opened to the sea between 1952 to1954 to provide a tidal prism adequate enough to supply cooling water for the San Diego Gas and Electric Company's Encina Power Plant located on the south side of the outer lagoon. The resultant deepening and tidal flushing created a new deepwater bay environment.

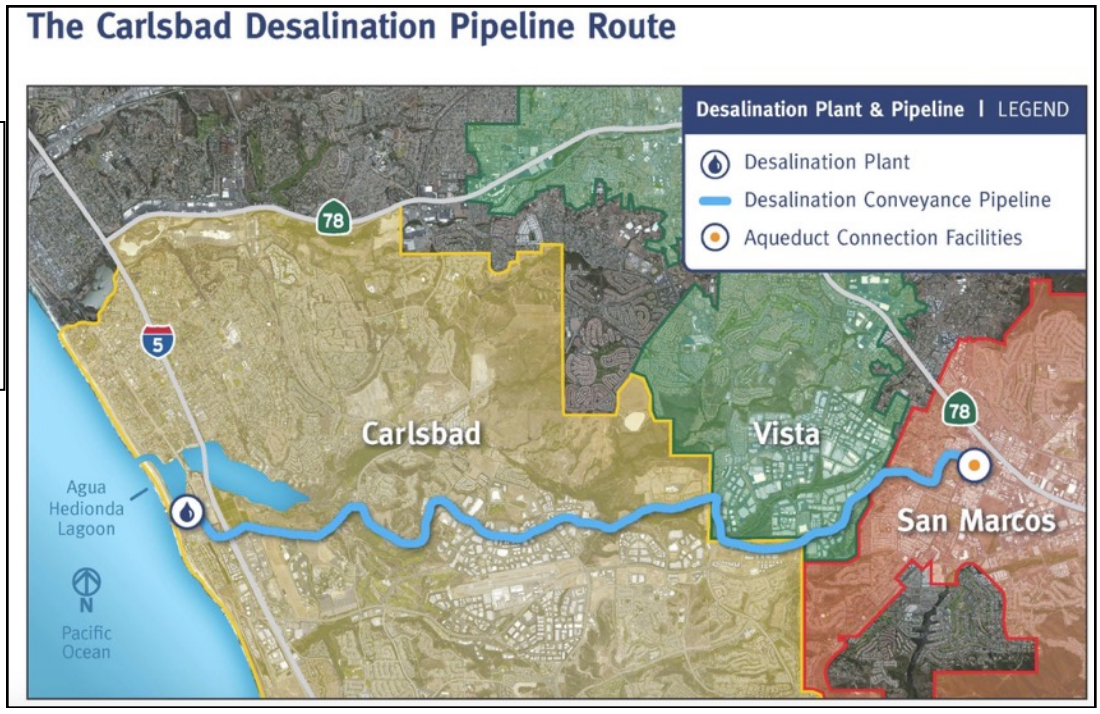


Figure 4: *Poseidon Water assumed stewardship of the lagoon in 2019. (Source: Carlsbad Desalination)*

The lagoon has been dredged every one to four years since 1954 as part of the Encina power plant operations. Regular dredging is needed to remove sand that slowly enters the lagoon and forms a large sand bar in the western-most part of the lagoon. Now that the Encina plant has been retired, Poseidon Water has taken over the dredging, as part of an agreement when the seawater desalination plant was

[1] *http://www.projectcleanwater.org/watersheds/carlsbad-wma/*

built and came online in 2015.[2] Sand replenishment from the dredging of the lagoon was originally expected to begin in November or December of 2020 but it now set to begin in 2021.

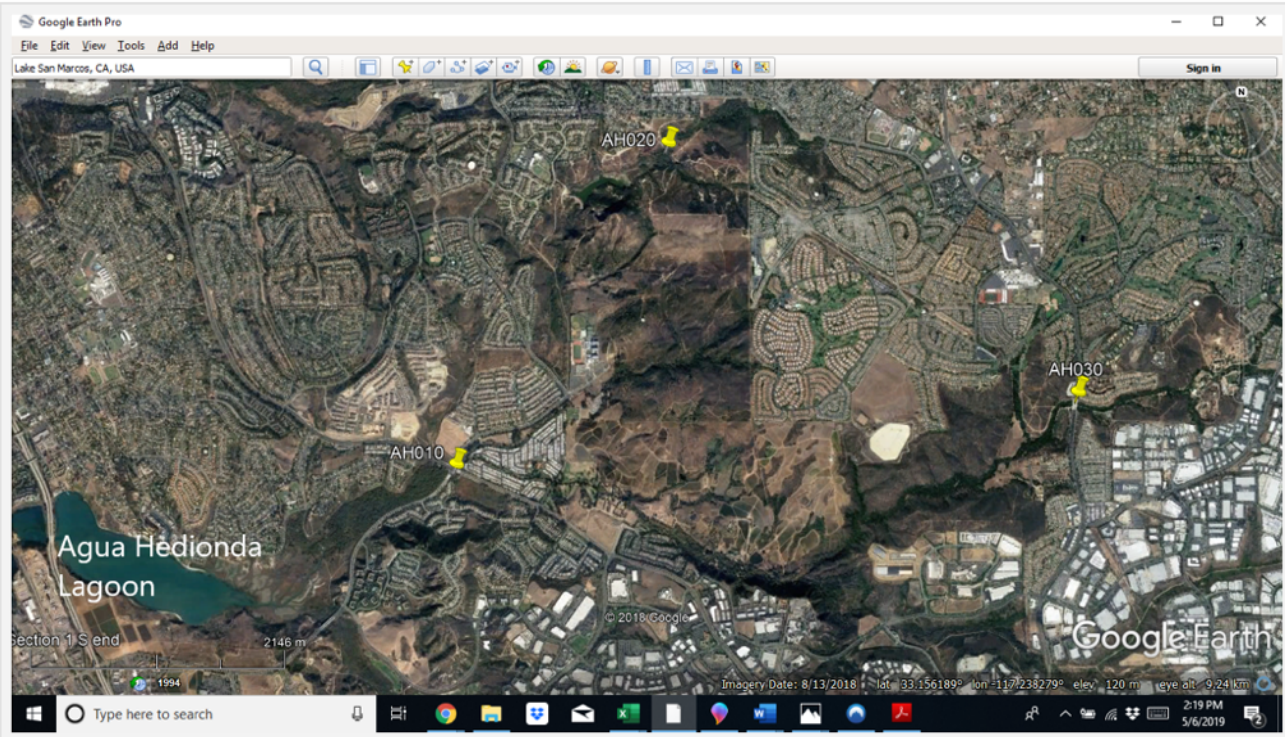
Purpose

The purpose of this annual report is to provide the water testing data for Agua Hedionda Creek Watershed that was collected during 2020. Each parameter will be evaluated for anomalies and the overall trends of the watershed will be summarized based upon this data. Monitoring was carried out in January, March, July,September and November of 2020. No data was collected in May due to the COVID Pandemic restrictions. The data will also be compared with our previous year's data of 2019 and also 2018 and 2017 data that was collected by San Diego Coastkeeper.

Sampling Sites

The Agua Hedionda Creek team sampled the sites AH010, AH020 and AH030 identified by the yellow pins in the map shown in Figure 5. A photograph of each site can be viewed in Appendix C:

- AHL010-Samples the convergence of Calavera Creek, Agua Hedionda Creek, and other tributaries. This site is located at the eastern end of lagoon before recreational areas; close to the intersection of Cannon Rd and El Camino Real. There is no public access in the sample area.
- AHL020-Samples Calavera Creek in the Lake Calavera Preserve in Carlsbad. This site is protected open space.
- AHL030-Samples Agua Hedionda Creek under south Melrose in Vista under the 78 Freeway bridge. This site is at the very eastern most edge of Buena Vista Park. There is residential development to the east and undeveloped lands to the west.



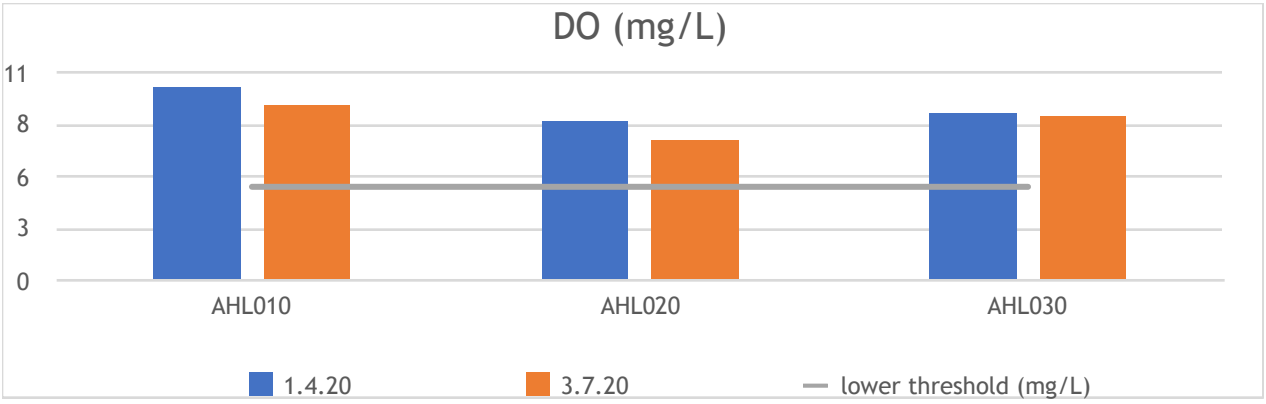
[2] https://www.carlsbadca.gov/news/displaynews.asp?NewsID=2277&TargetID=1

***Figure 5** - Agua Hedionda Creek sampling sites (Source: Google maps)*

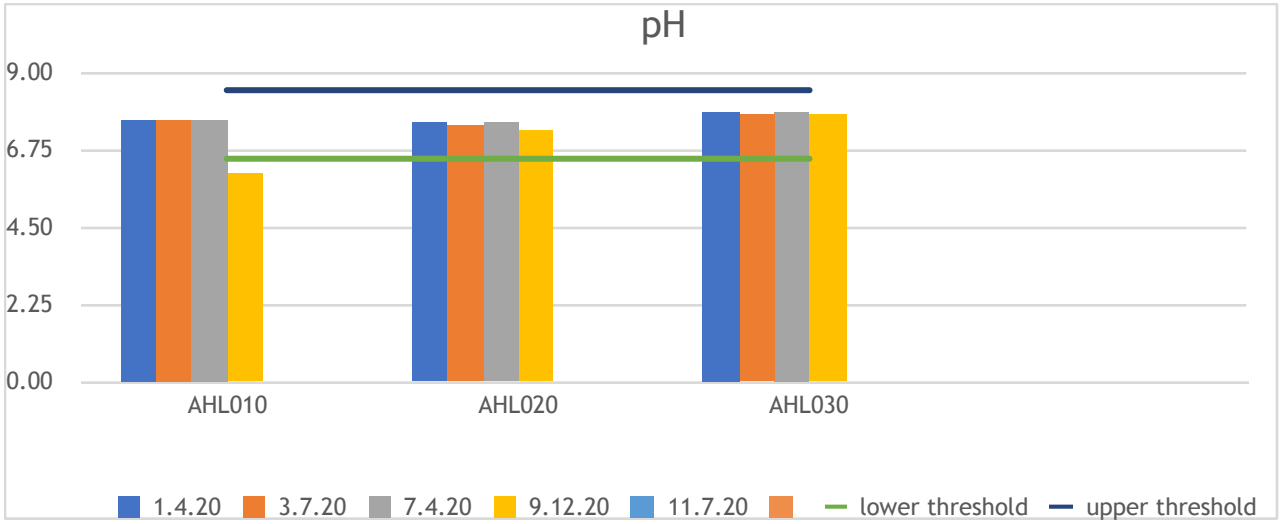
Test Data and Results: Missing data resulted from equipment malfunction and COVID restrictions as well as other individual factors. There was only a skeleton field team (only 2 people) due to COVID restrictions after March. Hach meters were not taken into the field. pH and conductivity were only done at the lab. There were no dissolved oxygen measurement taken. In November field data was collected on Nov. 11 (other sites done 11/7) and there were no readings for PH or conductivity done in the lab.

Field Parameters

Dissolved Oxygen: San Diego Basin Plan[4] threshold level for dissolved oxygen is of 5.0 mg/L.or above. Dissolved oxygen was above the threshold level at all sites.. These levels represent a sufficient amount of oxygen in the water for a healthy ecosystem. Data is only available for January and March.

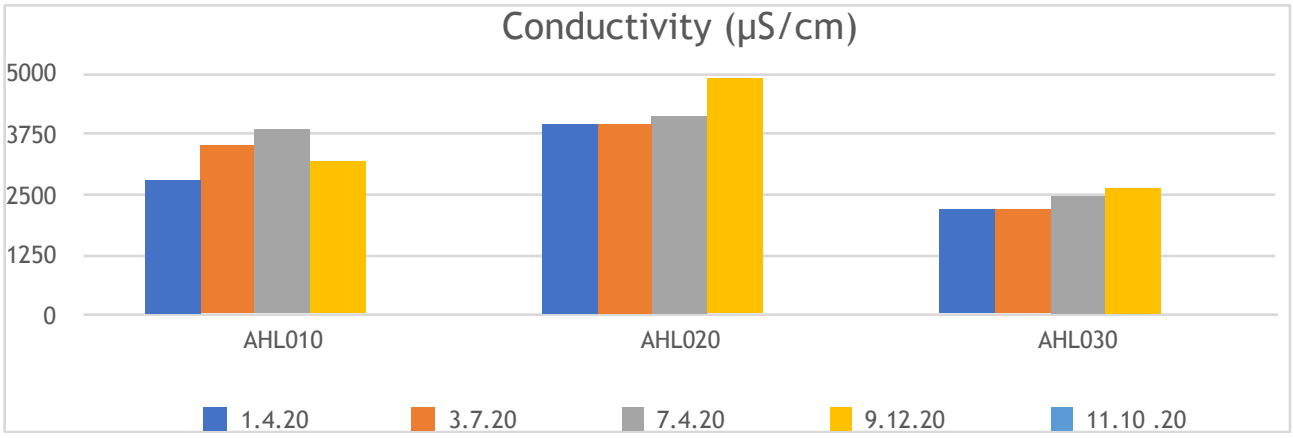


pH: The pH ranged from 6.1 to 7.85 for all sites. Data is missing for 11/7. All values fall within the acceptable range for the San Diego Basin Plan of 6.5-8.5 except for 9/12 which measured a lower than acceptable value.



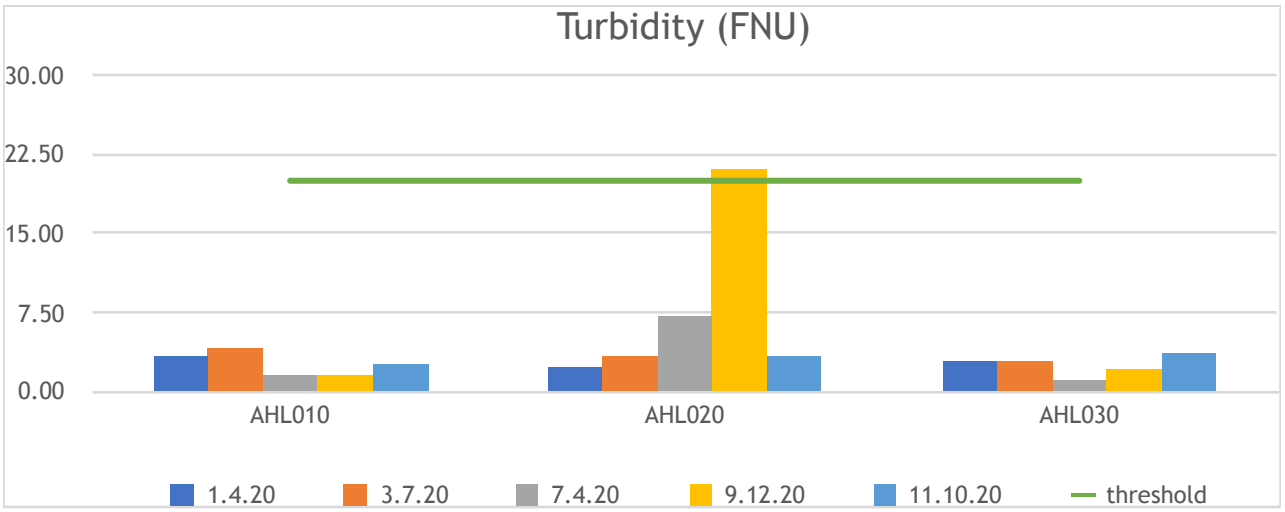
Conductivity: Conductivity fluctuated between 2189 - 4907 µS/cm. There is no threshold for conductivity, it merely reflects the amount of dissolved minerals in the water, however, the California Waterboard typically sees levels between 100-2000 µS/cm in freshwater streams *(Electrical Conductivity/ Salinity Fact Sheet*).

Conductivity was lower at site AHL 030 but all sites showed higher values than those typically seen in other freshwater streams in California. There was no data available for 11/10.



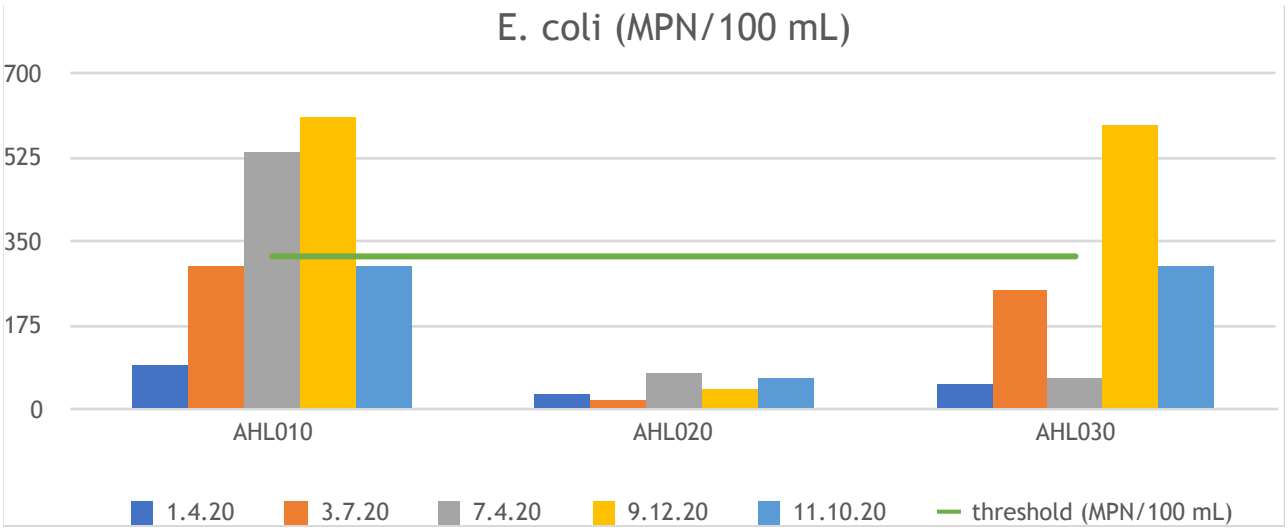
Laboratory Tests-Turbidity (cloudiness), total coliform, *Escherichia coli (E. coli)*, nitrates, total phosphorus, reactive phosphorus and ammonia are measured in the lab using 'grabbed' samples transported from the field.

Turbidity: High turbidity can hinder the quantity light penetrating water which may affect photosynthesis. The threshold is 20 FNU. With one exception at AHL 020 on 9/12, all turbidity reading were well below the threshold limit. AHL 020 was slightly above on 9/12 reading 21.2 FNU. Because collection site water depth data is missing, it is not possible to know if this was due to low water depth.

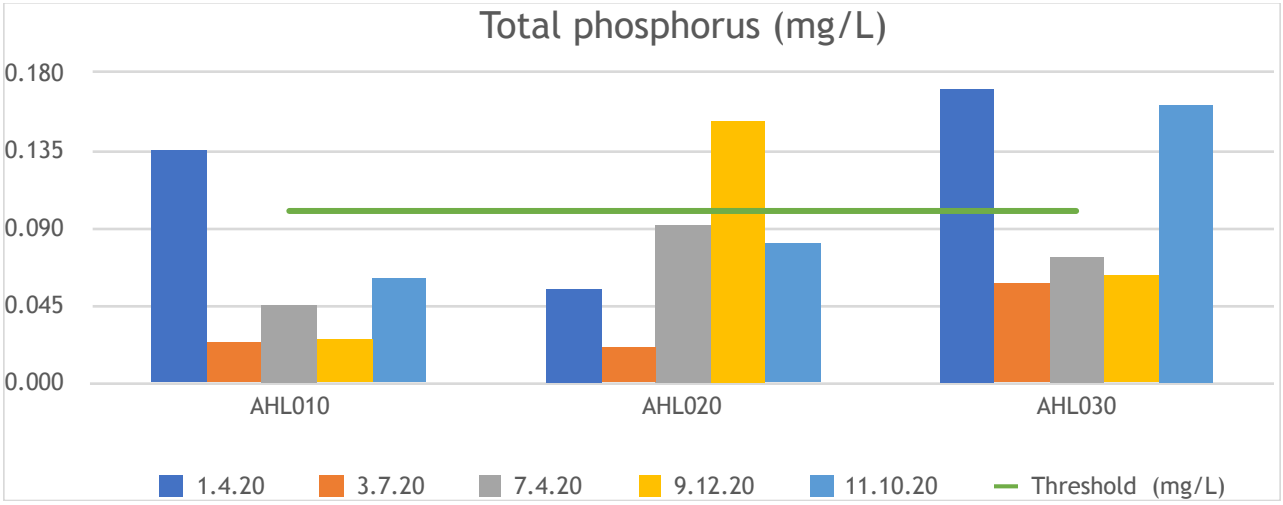


E. coli: Coliforms are a group of bacteria found in the digestive tracts of animals, including humans and their waste products. They are also found in plant and soil material. They may or may not indicate pathogenic bacteria. There is no threshold for these bacteria due to the wide types of sources. *E. coli*, however, is much more indicative of potential concern as many strains are pathogenic. The test we run, using IDEXX Quanti-tray/Colilert, measures all *E. coli*, pathogenic or not. The threshold for this bacteria is 320 MPN/100 mL[3].

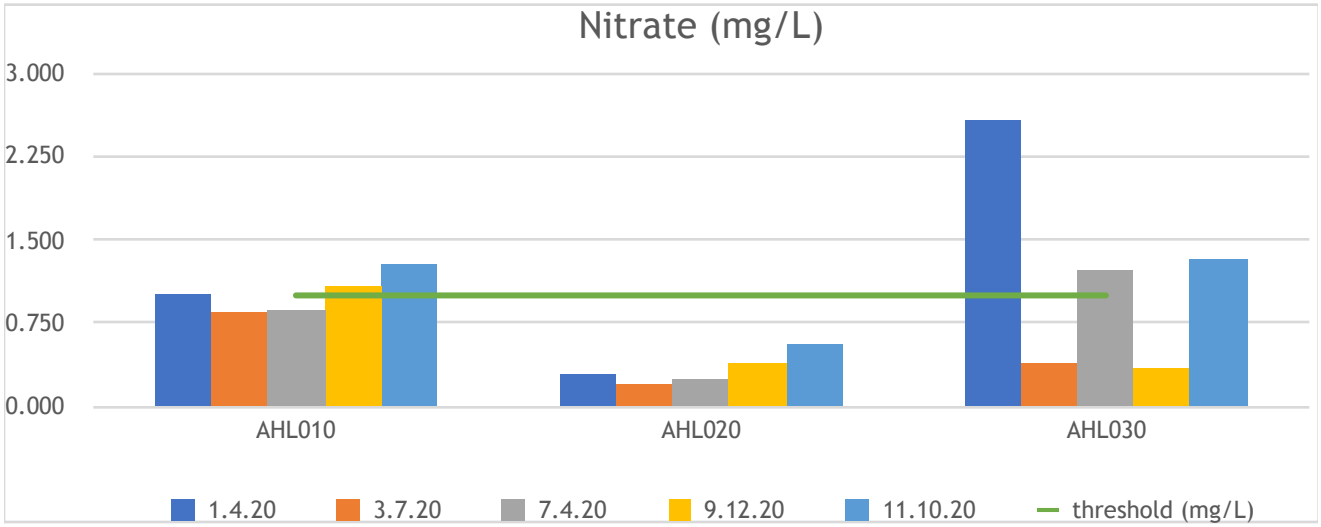
There was a lot of fluctuation of *E. coli* levels within sites AHL 010 and 030. Site AHL 010 showed the highest levels of *E.Coli* and had values above the threshold on two test dates. Site AHL 030 had a value above threshold on 9/12. Site AHL 020 which was consistently well below the threshold level on all testing dates.



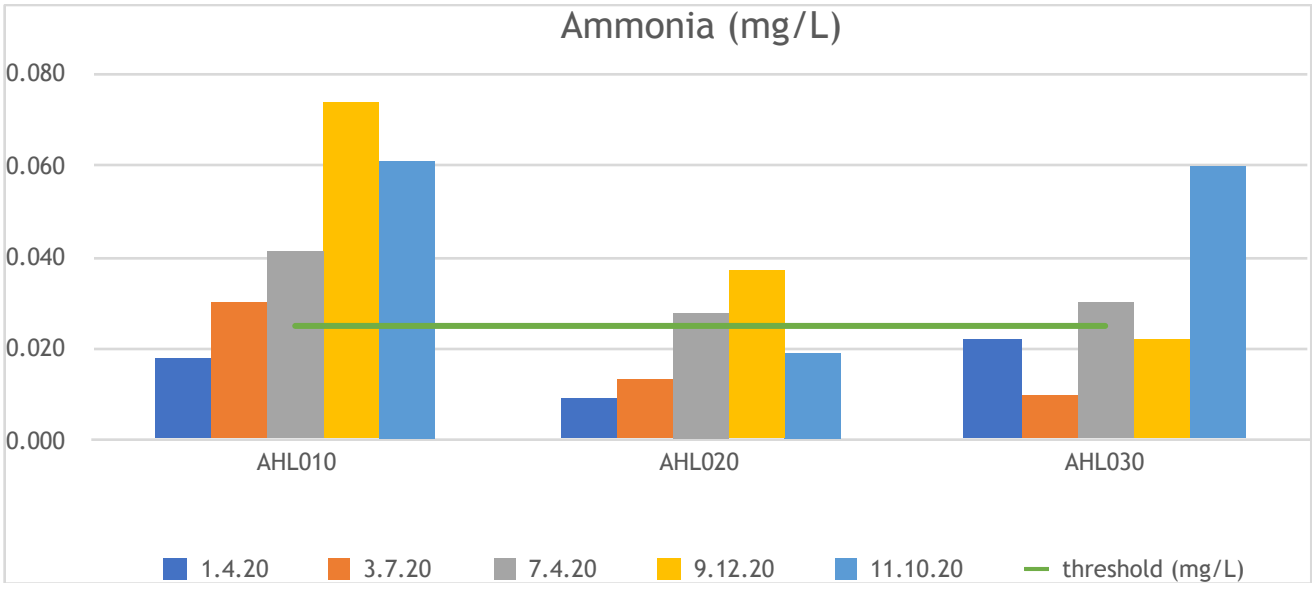
Total Phosphorus: Elevated phosphorus is often the result of fertilizer runoff and can lead to algal blooms. The threshold for San Diego watersheds is 0.1 mg/L[3]. Total phosphorous levels were variable but all three sites showed above threshold readings at one test date and AHL030 had elevated reading on two different dates.



Nitrates: Nitrates generally enter waterways from fertilizer runoff. Threshold level for nitrates is 1.0 mg/L. Values for nitrates fluctuated among the three test sites. AHL020 was well below the threshold level at all test dates. At site AHL010 values hovered right around the threshold; either slight above or slightly below. AHL 030 values were quite variable and the 1/4 test date was more than 2.5 times above the threshold.



Ammonia- Ammonia is another form of nitrogen. It can cause direct toxic effects on aquatic life. Ammonia can enter waterways through direct means such as municipal effluent discharges and the excretion of nitrogenous wastes from animals, and indirect means such as and runoff from agricultural lands. Ammonia's threshold is 0.025 mg/L. Ammonia measurements fluctuated across all sites and dates. The highest ammonia levels were found a site AHL010; four out of five readings were above threshold. Sites AHL 020 and 030 each had two measurements above threshold value.



Data Comparison With Previous Years

San Diego Coastkeeper's testing procedures and protocols were followed when the testing was taken over by NSDCWMP but the testing months had been very inconsistent during the previous testing years; 2017-2019 (See Appendix A). Missing and inconsistent testing dates does make data comparison challenging. Going forward, NSDCWMP plans to complete regular bimonthly testing each year. Data was collected five times in 2020; January, March, July, September and November; no data was collected in May Due to COVID restrictions.

Dissolved Oxygen

Dissolved oxygen measurements in 2020 were only collected in January and March. All values were above threshold at all sites. In previous years, no data has been collected during these months. It can be noted that January and March are cooler months and the measurements were well above threshold. In fact, 2020 measurements were highest recorded to date. It is difficult to know the significance of this until we are able to sample again in January and March since dissolved oxygen level fluctuate due to water temperature.

pH

pH continued to fall within the acceptable range for 2020 as it had with the previous three test years. There was one exception this year as site AHL 010 had one measurement slightly below the acceptable range in September.

Turbidity

Turbidity measurements for sites AHL 010 and AHL 030 were well below threshold in 2020. This was generally the case for measurements from 2017-2019. Most measurements at Site AHL 020 were well under threshold, although the measurements were generally higher than Sites AHL 010 and AHL 020.

There were two exception at Site AHL 020, one in 2019 and one in 2020. It is difficult, with limited turbidity data as well as missing water depth data, to discern the effects of low water levels. It can be noted.

E. coli

In 2020, *E. coli* measurements followed trends from previous years, although data at this point is limited. At sites AHL 010 and AHL 030 during cooler months levels were below threshold but readings tended to rise well above threshold in warmer months.

Site AHL 020 showed well below threshold levels throughout 2020 and there did not seem to be an effect related to seasonal temperatures. This is also generally the case for data in 2017-2019 (with one exception in October 2018 above threshold).

Total Phosphorus

Site AHL 010 showed higher levels of phosphorous than previous years for comparable data; although all were below threshold. January 2020 measurement was above threshold but there is no comparable data for that month.

Site AHL 020 does show slightly higher phosphorous levels for 2020 than previous years but still well below threshold limit.

Site AHL 030 showed no clear trends but continued to have below threshold total phosphorous measurements as was the case in previous years.

Nitrates

Site AHL 010 had nitrate levels consistently below threshold level through September of 2019. In November of 2019, nitrates went above threshold and this level continued into 2020. In 2020, three of the five test readings were at or above threshold. The other two readings were high but below threshold.

Site AHL 020 was consistent with previous years; having all measurements well below threshold value.

There are only two data points for site AHL 030 prior to 2020 and both show well below threshold values. There are three measurements in 2020 which show above threshold nitrates. It is difficult with so little previous data to make comparisons.

Ammonia

At Site AHL 010, ammonia levels have been near or above threshold levels since testing began in 2017. This continued to be the case in 2020, as well.

Site AHL 020 continues to show mixed results within each year and across years from 2017 through 2020. There are well below threshold and above threshold measurements scattered throughout the data.

Site AHL 030 had only two measurements prior to 2020, one in 2018 and one in 2019, and both were well below threshold. In 2020 there were two data points just below threshold and one above threshold but once again, more data will be necessary before comparisons can be made.

Discussion Points

Almost a complete year of data was gathered for 2020. Only the month of May data is absent due to COVID restrictions in place at the time although here were still gaps in data collection. Dissolved oxygen data was only collected during January and March at all sites and pH and conductivity data were not done for November. We are hopeful to obtain a full year of data for 2021. Having a regular bimonthly collection schedule continue into next year should add a new dimension to studying our results.

We will continue to monitor *E. coli* levels and notify the appropriate agencies as deemed necessary.

Appendix A: San Diego Coastkeeper's Spreadsheet Data 2017 and 2018

San Diego Coastkeeper's data for Agua Hedionda Creek 2017

2017-mo	Site	DO mg/L	Con-duct µS/cm	PH	Tur-bidity (FNU)	Ttl Phosp mg/L	Reac Phos mg/L	Ni-trate mg/L	Am-monia mg/L	Total Colif MPN/ 100mL	E Coli MPN/ 100mL
Aug	AHL010	4.34	3536	7.53	1.2	0.001	0.015	0.477	-0.01	3873	1664
Sept	AHL010	3.62	4273	7.7	1.34	0.012	0.039	0.371	0.057	2247	670
Oct	AHL010	4.57	4345	7.79	0.635	-0.073	0.123	0.271	0.056	2755	109
Nov	AHL010	5.84	4557	7.79	0.797	0.013	0.018	0.727	0.046	224	230
Nov	AHL020	4.36	5601	7.31	7.07	0.026	0.027	0.158	0.025	30	20
Dec	AHL010	7.71	4216	7.89	0.505	0.011	0.008	0.785	0.028	1285	613
Dec	AHL020	5.66	5190	7.47	6.35	0.025	0.015	0.049	0.014	771	98

Appendix A (continued)

San Diego Coastkeeper's data for Agua Hedionda Creek 2018

2018 -mo	Site	DO mg/L	Con-duct µS/cm	PH	Tur-bidity FNU	Ttl Phosp mg/L	Reac Phos mg/L	Ni-trate mg/L	Am-monia mg/L	Total Colif MPN/ 100mL	E. Coli MPN/ 100mL
Apr	AHL010	5.94	3840	7.71	0.757	0.011	0.013	0.544	0.025	1483	388
	AHL020	5.18	4287	7.52	3.6	0.015	-0.094	0.145	0.011	51	0
	AHL030	6.2	2370	7.87	0.71	0.064	0.065	0.22	0.004	1455	613
June	AHL010	4.82	4077	7.58		0.009	0.012	0.52	0.023	6867	905
	AHL020	3.81	4847	7.31		0.017	0.021	0.135	0.012	72	10
Aug	AHL010	3.32	4500	7.61	0.751	0.042	0.149	0.202	0.116	15531	3130
Oct	AHL010	2.51	4227	7.51	1.14	0.043	0.044	0.506	0.088	15531	1153
	AHL020	2.03	6927	6.36	6.53	0.02	0.03	0.155	0.032	1626	411
Dec	AHL010	7.34	2040	7.85							
Dec	AHL020	5.07	2860	7.25							
Dec	AHL030	6.32	914	7.63							

Appendix B: NSDCWMP Spreadsheet Data 2019:

2019-mo	Site	DO mg/L	Conduct µS/cm	PH	Turbidity FNU	Ttl Phosp mg/L	Reac Phos mg/L	Nitrate mg/L	Ammonia mg/L	Total Colif MPN/100mL	E. Coli MPN/100mL
July	AHL010	4.59	3980	7.45	3.32	0.015	0.015	0.734	0.039	>24196	1259
	AHL020	3.22	4778	7.16	27.5	0.01	0.016	0.185	0.018	3968	31
	AHL030	5.07	2470	7.70	3.05	0.081	0.086	0.136	0.017	4569	860
Sep	AHD010	3.72	4750	7.48	14.1	0.021	0.02	0.529	0.098	>24196	548
	AHD020	1.14	4830	6.89	122	0.132	0.127	0.390	0.209	2382	0
	AHD030-dry										
Nov	AHL010	6.62	4723	7.65	4.07	0.012	0.01	1.51	0.056	24196	281
	AHL020 - dry										
	AHL030-dry										

Appendix B (continued)

Additional spreadsheet data and notes 2019

Date	Site	Collection time	Collection site depth (")	Flow (N,B,M,R, F)	Ppt within 72 hr?	notes
7/6/19	AHL010	11:56 AM	7	3.5	N	stream wider and deeper since 2018 after dredging
7/6/19	AHL020	10:50 AM	7	2	N	water higher than usual
7/6/19	AHL030	9:30 AM	13	2	N	water higher than usual
7/6/19	AHL020 Field blank					
9/7/19	AHD010	11:59 AM	9	3	y	near homeless encampment, sediment much greater than field duplicate (by eye)
9/7/19	AHD010 FD	12:01 PM	9	3	y	
9/7/19	AHD020	10:28 AM	3.5	1	y	water clearly rust colored
9/7/19	AHD030-dry					
11/2/19	AHL010	10:32 AM	8	2	N	
11/2/19	AHL010 lab duplicate	10:32 AM				
11/2/19	AHL020 - dry					
11/2/19	AHL030-dry					
11/2/19	AHL010	10:32 AM	8	2	N	
11/2/19	AHL010 lab duplicate	10:32 AM				

Appendix B (Continued) : NSDCWMP Spreadsheet Data 2020

2020-Date	Site	Collection time	Avg DO (mg/L)	Avg Conductivity (uS/cm)	Avg pH	turbidity (FNU)	Total phosphorus (mg/L)	Reactive phosphorus (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)	Total coliform (MPN/100 mL)	*E. coli* (MPN/100 mL)
1/4/20	AHL010	12:10 PM	10.30	2803	7.62	3.24	0.136	0.177	1.001	0.018	6131	95
1/4/20	AHL020	11:02 AM	8.44	3937	7.57	2.40	0.055	0.039	0.286	0.009	336	31
1/4/20	AHL030	10:20 AM	8.85	2213	7.83	2.84	0.170	0.156	2.561	0.022	1674	52
3/7/20	AHL010	11:37 AM	9.29	3537	7.64	4.01	0.024	0.016	0.84	0.03	12033	301
3/7/20	AHL020	10:52 AM	7.46	3963	7.49	3.28	0.021	0.014	0.208	0.013	860	20
3/7/20	AHL030	9:55 AM	8.70	2189	7.80	2.73	0.058	0.040	0.394	0.01	1160	249
5/2/20	**no data**											
7/4/20	AHL010	10:30 AM	ND	3837	7.67	1.63	0.041	0.088	0.930	0.041	53.7	537
7/4/20	AHL020	11:21 AM	ND	4123	7.57	7.07	0.086	0.771	0.304	0.028	7.5	75
7/4/20	AHL030	12:13 PM	ND	2457	7.85	1.00	0.068	0.657	1.280	0.030	6.3	63
9/12/20	AHL010	10:30 AM	ND	3173	6.10	1.56	0.025	-0.046	1.09	0.074	61.3	613
9/12/20	AHL020	11:27 AM	ND	4907	7.28	21.10	0.152	-0.064	0.385	0.037	4.1	41
9/12/20	AHL030	12:12 PM	ND	2647	7.77	1.97	0.063	-0.015	0.35	0.022	59.4	594
11/10/20	AHL010	10:20 AM	ND	ND	ND	2.5	0.061	0.046	1.280	0.061	30.1	301
11/10/20	AHL020	11:55 AM	ND	ND	ND	3.43	0.081	0.034	0.546	0.019	6.3	63
11/10/20	AHL030	11:00 AM	ND	ND	ND	3.71	0.162	0.123	1.330	0.06	29.8	298

:

Appendix C: Site Photos taken April 19, 2021 Karen Merrill and Ellen Bartlett

Site AHL010

Site AHL 020

Site AHL 030